SCIENCE NEWS-LETTER

The Weekly Summary of Current Science

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SHADOW SHOOTERS

They Photographed The Moon's Shadow

(See page 285)

Vol. XVII No. 473

Cosmic Rays May Be Like Tiny Bullets

Physics

Experiments Verifying Concept Reported To Physicists

COSMIC rays, the invisible visitants from outer space that have been interpreted by Dr. R. A. Millikan as heralds of the creation of matter out of errant energy, do not come as steady, undulating streams after the manner of the older concept of light rays, but as separate, high-velocity particles, like tiny bullets.

This concept of the nature of cosmic rays has received support from the work of Dr. L. F. Curtis of the U. S. Bureau of Standards, reported before the recent meeting of the American Physical Society.

Dr. Curtis placed two electron counters, instruments adapted for the detection of the swift passage of these almost infinitely small, electric particles, one above the other. Between the two he inserted the poles of a powerful electro-magnet. It has long been known that electrons and other electrically charged particles can be pulled from their course by a magnetic field, and Dr. Curtis reasoned that if the cosmic rays were corpuscular in their nature he should be able to deflect them after they had struck and registered in the first electron counter, and before they had made contact with the second.

This occurred. When the electro-magnet was not in operation, the two electron counters would frequently register at practically the same instant. This was taken to indicate the impact of the same particle, as it passed through the two instruments successively. This interpretation was first applied by two German workers, Walther Bothe and Werner Kolhörster, the latter one of the pioneers of cosmic ray research.

But when Dr. Curtis turned on the current in his electro-magnet, the number of simultaneous registrations by his two electron counters was materially reduced, thus constituting a demonstration of the existence of a corpuscular radiation of very high energy.

Material Affects Tone

THE greatest care of master organ builders in selecting material is not in vain. One of two pipes, exactly alike in every dimension and differing only in the kind of material of which they are made, may give a beautiful tone and the other a very harsh sound, Dr. Dayton C. Miller and John R. Martin, two physicists of the Case School of Applied Science, Cleveland, Ohio, have found.

They made three organ pipes—one of wood, another of single-walled zinc and a third of double-walled zinc. The tones of each were unlike, and further differences were caused by touching the single-shell zinc pipe and by filling the double-shell pipe with water.

Water Stops Rays

PURE water, containing no mineral salts in solution, transmits ultraviolet light fairly well. But a little dissolved mineral makes a thin layer of water much less transparent to these invisible radiations. How little, Dr. Charles D. Hodgman of the Case School of Applied Science, Cleveland, Ohio, told the meeting. He found that a layer less than an inch thick of common lake water, taken from Lake Erie, and containing no more mineral than most city water, stops about a quarter of the longer-wave ultraviolet rays and nearly nine-tenths of the short-wave rays.

Radio and Weather

IF you get stronger radio reception from a station northwest of you it is likely to rain next day. If the reception is weaker than average, it is a sign of fair weather.

This new brand of weather wisdom was explained by Prof. R. C. Colwell of the University of West Virginia. Listening to station KDKA, Pittsburgh, night after night at his set at Morgantown, W. Va., Prof. Colwell discovered that whenever there was an area of low atmospheric pressure, presaging a storm, between the two cities, the strength of the signals was increased. When a high pressure area moved in, bringing fair weather in its train, the signal strength decreased.

Earth's Core Not Iron

PARTLY broken up and compressed molecules 2000 miles and deeper in the earth may account for this world's great weight, Dr. A. A. Bless, physicist at the University of Florida, reported.

The earth is much heavier than it would be if it were composed throughout of the materials found on its surface, and it is generally thought that this extra weight is supplied by an iron core. But Dr. Bless believes the dense material within the earth, whatever it is, would be lighter on the surface. Its molecules are ionized by the high temperatures, electrons being torn away from them, and thus the atoms are decreased in size, causing a sufficient increase in density to account for the observed mass of the earth, he explained.

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The Answer Is

In This Issue

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Mental Hygiene's Future Development

Mental Hygiene

Psychiatrist Predicts 950,000 Patients By 1970

By Dr. William A. White
President, First International Congress of Mental Hygiene

APPROXIMATELY one-half of all the hospital beds in the United States are for mental cases, and the last survey of the hospital situation showed that the beds for mental cases were increasing more rapidly than for all other classes put together.

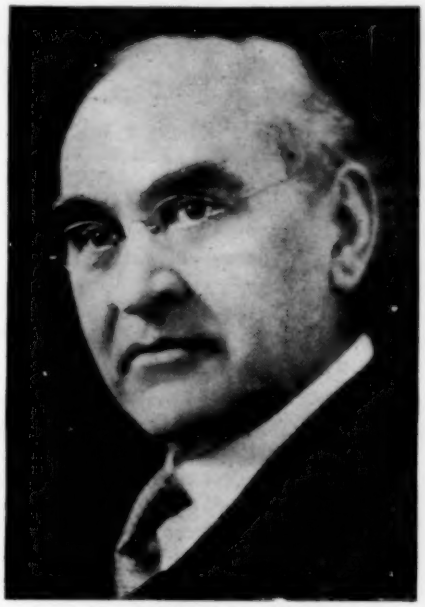
This condition of affairs has led the statisticians to make some rather interesting estimates, which, roughly speaking, are these: that in 1970 the United States will have a stable population of approximately one hundred and fifty million people. The various augmenting and retarding factors will have come to a state of comparative equilibrium by that time.

The number of patients in hospitals for mental disease in 1970, based upon the standards which are at present operative, will be, in round numbers, 950,000. What this figure means can be more easily understood if we realize that in 1880 the number of patients per 100,000 of the general population who were in such hospitals was 63; whereas the 1970 figure will represent 635 per 100,000, in other words—merely one-thousand per cent. increase in a century.

The above figures indicate the tremendous importance of the problem of mental disease. It represents inefficiency on the part of over five per cent. of the population of a sufficient degree to necessitate institutional care. This means, of course, a tremendous burden, not only economic, but in various other ways upon the rest of the population, and particularly upon the immediate family. Represented in actual dollars and cents, the figure for such a degree of crippling would be staggering.

It is my feeling that unless times change very materially it will be the tremendous economic pressure which will force an increasingly acute consideration of this tremendously important public health problem.

I believe that mental hygiene in some of its aspects will become, as a necessary result, a part of the regular curriculum of medical schools and probably of academic courses; that physicians will recognize the psychological factor in disease much more fully; that general hospitals will have wards, as they are already beginning to, for the reception and care of acute mental illnesses; that the educational system will be much more keenly alert than it is at present to determine the existence among the student body of potential mental disorder; that great executives will become conscious of the part it plays in creating the lost motion in their organizations; and that in all these ways it will be more frequently and effectively identified.



Dr. William A. White

Almost 2,000 specialists in treatment and prevention of mental disease are coming to Washington from Europe, the Orient, and all parts of America to confer together at the First International Congress of Mental Hygiene. The congress will be held in Washington, May 5 to 10. President Hoover is the Honorary President, and Dr. William A. White, Superintendent of St. Elizabeth's Hospital of this city, is named as President.

No formal, learned papers will be read before the assembled delegates at this congress. Instead, those scientists who have been asked to bring their newest theories and researches to Washington are preparing in advance lengthy accounts of their work. This material will be translated into English, French, German, and probably Spanish, and copies will be furnished to the psychiatrists, phychologists, educators, doctors, and sociologists who wish to discuss the various topics. The original writers of the papers will be allowed only ten minutes to sum up their work before the discussion begins, for the greatest benefit of the meeting is expected to come from the exchange of ideas and information between the mental health specialists of thirty countries.

It is necessarily to be believed, in conjunction with these developments, that an improved, a more adequate therapeutics will grow up along side of this increasing number of patients and that we shall continue to find, as we already do, that a very material percentage of liabilities can be converted into assets. What the relation will be between the therapeutic successes and failures it is pretty difficult to even guess.

Aside from all of these developments, which are not difficult to foresee, however, one must believe that the future of mental disorders, even the immediate future—the next twenty-five years—will show a very radical change of attitude on the part of the people at large and of the medical profession in particular, toward mental diseases. Along with a broader knowledge of their significance and a better understanding of their meaning there will be a greater tolerance for some of their symptoms. There will be less inclination to resent, hate, and punish the offender. And society will necessarily come to the realization that mental disease is only an exaggerated form of mal-adaptation, which is only another way of saying, by the use of a sociological term, unhappiness.

People will realize that the mental mechanisms involved are the same and that all the various forms of mental disorder, social inefficiency, and personal unhappiness must become the subjects, not of criticism and resentment, but of scientific study with a view to their correction or improvement; that they are as worthy of such study as are the diseases of the body, and, as a matter of fact, from the point of view of the most valuable of man's possessions—his mind—they are more worthy and more important.

Society will also have to realize that all of these troubles of the mind are one of the prices it has to pay for civilization, and inasmuch as it will not throw away civilization, and could not if it would, it will get down to the concrete problem of an attempt at as great an understanding of man by himself as he has hitherto gained of his environment.

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Mental Work Takes Few Calories

General Science

National Academy of Sciences Holds Its Annual Spring Meeting

IF you eat one oyster cracker or one-half a salted peanut you will get enough extra calories for one hour of intense mental effort, Dr. Francis G. Benedict, director of the Nutrition Laboratory of the Carnegie Institution stated at the meeting this week of the National Academy of Sciences.

With his wife, Mrs. Cornelia Golay Benedict, this scientist has studied the effects of mental effort on the energy requirements of the body.

"The popular tradition that fish is a brain food has given way to the idea that mental effort demands calories," he said in reporting the experiments which he and his wife have conducted.

"It is the experience of nearly everyone that intense, sustained mental effort results in a feeling of profound fatigue, not only in mind but likewise in the entire body. The disposition to seek instinctively fresh air, to open a window and to stretch the limbs after a period of mental work is pronounced.

"When one considers the sense of extreme, almost overpowering fatigue in both mind and body following a sustained mental effort, it is surprising that there is such an insignificant effect upon the general metabolism or level of vital activity," Dr. Benedict commented on the results of his and Mrs. Benedict's experiments.

The two scientists first measured the energy requirements of the body when resting, twelve hours after the last meal and when the mind was as nearly free from activity as possible. Observations were also made of the rate and character of breathing and of the heart rate.

Then the same measurements and observations were made while the person being observed was doing problems in mental arithmetic. The problems consisted of multiplying in his mind such figures as 76 by 69. They were given in a clear voice by the investigator. The person doing them indicated by a tap on a telegraphic key that he had solved the problem, whereupon a new one was given him.

The same observations and measurements were also made during attention periods when the subject responded, by tapping the telegraphic key, to such stimuli as flashing lights or the ringing of a buzzer.

The scientists found a noticeable increase in the heart rate, a considerable change in the character and type of the breathing movements, an increase in the volume of air passing through the lungs, a small increase in the carbon dioxide produced and a smaller increase in the oxygen consumed by the body during the periods of mental effort.

The increase in oxygen consumption, which may be taken as the best index of energy transformations, is such as to suggest that the increase in heat production as a result of intense mental effort of this type is very small, Dr. Benedict explained.

"The professor absorbed in intense mental effort for one hour has an extra demand for food or for calories during the entire hour not greater than the extra needs of the maid who dusts off his desk for five minutes," Dr. Benedict stated.

Optical Slicing

A POWERFUL new weapon of research, a microscope that can dissect a cell photographically while it is still alive without cutting it or even touching it, was described by Francis F. Lucas of the Bell Telephone Laboratories, New York.

Employing invisible ultraviolet rays of a single wave-length and using photographic plates instead of the human eye, Mr. Lucas is able to section optically living normal and malignant cells at very high magnifications and with a degree of precision never heretofore achieved.

The average living cell is about one three-thousandth of an inch in diameter. With his new invention, Mr. Lucas can "slice" such a cell into sections spaced about one one-hundred-thousandth of an inch apart and photograph each section without materially interfering with the normal behavior of the cell. In the average cell thirty or more photographs may be taken on uniformly spaced optical planes. The whole architecture of the living contents can be pictured at magnifications as high as 5,000 diameters.

Fish Hearing

FISH have a good sense of hearing. They can perceive vibrations too low for the human ear to catch, and can hear sounds clear to the highest notes of piano or violin range and a little beyond.

Dr. Karl von Frisch of the University of Munich told how he wormed out of a collection of minnows the answer to the much-disputed question of how well fish can hear.

He appealed to the fish in the way that is said to bring the best results with men: through their stomachs. He offered them food, at the same time sounding a tuning-fork or blowing a whiste. After a while the minnows came to know that the sound meant dinner-time, and would come crowding up to the feeding place when they heard it, leaping and scrambling for the expected food.

Dr. von Frisch taught the fish to distinguish between sounds, by feeding them to the accompaniment of one note, and scaring them off with a tap of a glass rod when he sounded another. In this way he learned how small an interval in pitch they could discern. The minnow with the best musical ear could distinguish perfectly the two sounds of a minor third—the "la-do" interval.

The German scientist stated that he could not find a vibration rate that the fish could not hear. The lowest rate of any of his tuning forks, sixteen to the second, seemed to be perfectly perceivable to them. Some of his experiments indicate that fish may have two sets of organs for detecting sound: the ear for medium and high pitched notes, and some other organ for the slow vibrations.

More Air Power

TRI-MOTORED airplanes will fly just as fast on one motor as they do now on three when designers learn how to make machines so that the flow of air around them is smooth and free from eddies.

This thought from the address of Dr. Joseph S. Ames, president of Johns Hopkins University and chairman of the National Advisory Committee for Aeronautics, indicates the importance of scientific investigation

to improve the aerodynamic efficiency of airplanes.

"Careful estimates prove that if all the parts of the machine were designed so the flow of air around it were smooth and free," Dr. Ames explained, "the airplane could maintain its speed with roughly only one-third the power ordinarily used. This fact points to the possibility and need of reducing drag by the proper design."

The drag of the different parts of a plane like the wings, engine and fuselage can be studied separately in wind tunnels now in existence, it was pointed out. The drag of the machine as a whole, however, may be twice as great as the sum of the drag of its parts, due to distortion of flow when the parts are combined, Dr. Ames said.

"This additional drag, called interference drag, can be studied only by placing the entire airplane in the throat of a wind tunnel," he pointed out. "There is not in existence at the present time a tunnel of sufficient size to hold a modern airplane, but one is under construction by the National Advisory Committee for Aeronautics at its laboratory at Langley Field, Va. Fortunately this laboratory now has in operation a tunnel having an open throat 20 feet in diameter, which is the largest in the world. This is provided with engines sufficient to produce an airstream having a velocity in excess of 100 miles per hour."

In naming some problems that have been solved in wind tunnels, Dr. Ames described a cowling or hood for standard air cooled engines which, he said, results in an increase of speed of approximately 20 miles per hour for the ordinary commercial airplane.

Tuberculosis

EVOLUTION while you wait has been observed in cultures of tuberculosis bacilli by Dr. S. A. Petroff, bacteriologist of the Trudeau Sanatorium, N. Y.

From cultures of avian tuberculosis, which is an affliction of birds, Dr. Petroff has isolated what seem to be three distinct varieties of the germ. They grow differently, react differently to chemical and physical treatment, and have different physiological effects. One of the three types is quite virulent in its effects on chickens, the other two less so.

Similarly, from the tuberculosis of cattle a series of three cultured varieties was obtained. Their general appearance in mass was the same as that of the corresponding three types from the avian bacilli. They resembled them also in that one variety was strongly pathogenic, this time toward guinea pigs and rabbits, while the other two were less so.

Human tuberculosis germs proved less susceptible to separation into distinct strains or varieties. Dr. Petroff had best success with the long-cultured and somewhat vitiated "BCG" bacilli, which are used in the preparation of a vaccine widely used on infants in France. These bacilli separated out into two varieties, one of which had considerable effect on guinea pigs but little on rabbits, while the second variety appeared to be harmless to both animals. Cultures derived directly from human tuberculosis could not be separated into stable varieties. Dr. Petroff is of the opinion that human T. B. germs do produce many varieties, but that these do not "stay put" under laboratory conditions.

Dr. Petroff found it possible to convert one type of his bacilli into another by suitable culture methods, changing a virulent form into a mild one and vice versa.

This variability of the bacilli of different types of tuberculosis, and the instability of a variety that workers may succeed in isolating, agrees with fluctuating changes that have been found in other bacteria. The physiological changes that take place in the germs may supply a basis for the understanding of the wide variability in tuberculosis as found in human patients, which has always been a puzzle to doctors.

Centrifuge-Microscope

A MICROSCOPE fitted to a high-speed centrifuge, making it possible to watch living cells as they are whirled about at a speed of from 2000 to 3000 revolutions a minute, is the powerful new weapon of biological research described by Prof. E. Newton Harvey of Princeton University and Alfred L. Loomis, banker-scientist of Tuxedo Park, N. Y.

The instrument, constructed in the private laboratory of Mr. Loomis, consists of a rapidly rotating frame on which a glass slide, bearing the cell to be studied, can be mounted. As the frame whirls, the various parts of the cell's living contents are thrown toward the outside by centrifugal force.

Travelling with the microscope slide is the powerfully magnifying object-lens of a microscope, so placed that it can be kept in focus on the cell under observation. By means of two reflecting prisms the image it forms is reflected out through an eyepiece placed directly over the center of the instrument. Through the latter lens the observer watches the course of events in the whirling cell.

Light to illuminate the experiment is supplied from a new type of mercury vapor lamp, the invention of Mr. Loomis. It is so constructed that it can be flashed on and then off again in so small a fraction of a second that it can hardly be called time at all; yet it gives full illumination while it is turned on. This intermittent illumination is necessary because if there were light shining on the cell all the time the image under the eyepiece would be nothing but a spinning blur. But by catching it at just one point in its circuit at each revolution, the series of instantaneous flashes string themselves together like the intermittent flashes of the motion picture on the screen, and appear to the observer as a steady, stationary picture. So steady is the image, Prof. Harvey reported, that perfectly clear photographs have been made.

Nerve Telephony

THE nerve of hearing carries the impulses it receives when stimulated as a minute fluctuating electric current, very similar to the current in a telephone circuit. So much alike are they that a telephone receiver can be "hooked up" with the auditory nerve, and the current, after amplification by means of vacuum tubes, will reproduce sounds received by the ear.

Ernest Glen Wever and Charles W. Bray of the psychological laboratory of Princeton University told how they made this discovery. They inserted an electrode in the auditory nerve of a cat, grounded the other end of the circuit elsewhere on the animal's body, and after amplifying the current "listened in" with a telephone receiver.

"We found that sound stimuli applied to the ear of the animal are reproduced in the receiver with great fidelity," the experimenters reported. "Speech is easily understandable. Simple tones, as from tuning forks, are received at frequencies which, so far as the observer can determine by ear, are identical with the original."

Sounds of wave frequencies as high as 3,300 per second, approximately the top of the violin range, were audible.

Roentgen's Discovery Of X-Rays —A Classic Of Science

Physics

ON A NEW KIND OF RAYS by W. C. Röntgen. First Communication, December, 1895. In ROENTGEN RAYS, Memoirs by Röntgen, Stokes and J. J. Thomson. Translated and edited by George F. Baker. New York, 1899.

The electric discharge through a vacuum tube was not new in 1895. Nearly every important physics laboratory in the world had one of the tubes. Others beside Roentgen who used such a tube in the dark must have noticed the fluorescence which it induced in certain substances. Many physicists were complaining of the unaccountable exposed appearance of photographic plates kept in the laboratories where these tubes were set up. Roentgen took time to turn aside from his work with the vacuum tube to investigate the strange invisible light which seemed to emanate from it, and so gave the world the great boon of X-rays. Their discoverer did not at first recognize their relationship to light waves, and thought they might perhaps be a different sort of wave motion in the ether. He failed to produce with them the characteristic phenomena of light waves because he used lenses and prisms of too gross a structure to affect the minute vibrations of the X-rays.

IF the discharge of a fairly large induction-coil be made to pass through a Hittorf vacuum-tube, or through a Lenard tube, a Crookes tube, or other similar apparatus, which has been sufficiently exhausted, the tube being covered with thin, black card-board which fits it with tolerable closeness, and if the whole apparatus be placed in a completely darkened room, there is observed at each discharge a bright illumination of a paper screen covered with barium platino-cyanide, placed in the vicinity of the induction-coil, the fluorescence thus produced being entirely independent of the fact whether the coated or the plain surface is turned towards the discharge-tube. This fluorescence is visible even when the paper screen is at a distance of two metres from the apparatus.

It is easy to prove that the cause of the fluorescence proceeds from the discharge-apparatus, and not from any other point in the conducting circuit.

2. The most striking feature of this phenomenon is the fact that an active agent here passes through a black card-board envelope, which is opaque to the visible and the ultra-violet rays of the sun or of the electric arc; an agent, too, which has the power of producing active fluorescence. Hence we may first investigate the question whether other bodies also possess this property.

We soon discover that all bodies are transparent to this agent, though in very different degrees. I proceed to give a few examples: Paper is very transparent;[1] behind a bound book of about one thousand pages I saw the fluorescent screen light up brightly, the printers' ink offering scarcely a noticeable hinderance. In the same way the fluorescence appeared behind a double pack of cards; a single card held between the apparatus and the screen being almost unnoticeable to the eye. A single sheet of tin-foil is also scarcely perceptible; it is only after several layers have been placed over one another that their shadow is distinctly seen on the screen. Thick blocks of wood are also transparent, pine boards two or three centimetres thick absorbing only slightly. A plate of aluminum about fifteen millimetres thick, though it enfeebled the action seriously, did not cause the fluorescence to disappear entirely. Sheets of hard rubber several centimetres thick still permit the rays to pass through them.[2] Glass plates of equal thickness behave quite differently, according as they contain lead (flint-glass) or not; the former are much less transparent than the latter. If the hand be held between the discharge-tube and the screen, the darker shadow of the bones is seen within the slightly dark shadow-image of the hand itself. Water, carbon disulphide, and various other liquids, when they are examined in mica vessels, seem also to be transparent. That hydrogen is to any considerable degree more transparent than air I have not been able to discover. Behind plates of copper, silver, lead, gold, and platinum the fluorescence may still be recognized, though only if the thickness of the plates is not too great. Platinum of a thickness of 0.2 millimetre is still transparent; the silver and copper plates may even be thicker. Lead of a thickness of 1.5 millimetres is practically opaque; and on account of this property this metal is frequently most useful. A rod of wood with a square cross-section (20 x 20 millimetres) one of whose sides is painted white with lead paint, behaves differently according as to how it is held between the apparatus and the screen. It is almost entirely without action when the X-rays pass through it parallel to the painted side; whereas the stick throws a dark shadow when the rays are made to traverse it perpendicular to the painted side. In a series similar to that of the metals themselves their salts can be arranged with reference to their transparency, either in the solid form or in solution.

3. The experimental results which have now been given, as well as others, lead to the conclusion that the transparency of different substances, assumed to be of equal thickness, is essentially conditioned upon their density: no other property makes itself felt like this, certainly to so high a degree.

The following experiments show, however, that the density is not the only cause acting. I have examined, with reference to their transparency, plates of glass, aluminium, calcite, and quartz, of nearly the same thickness; and while these substances are almost equal in density, yet it was quite evident that the calcite was sensibly less transparent than the other substances, which appeared almost exactly alike. No particularly strong fluorescence of calcite, especially by comparison with glass, has been noticed.

4. All substances with increase in thickness become less transparent. In order to find a possible relation between transparency and thickness, I have made photographs in which portions of the photographic plate were

1 By "transparency" of a body I denote the relative brightness of a fluorescent screen placed close behind the body, referred to the brightness which the screen shows under the same circumstances, though without the interposition of the body.

2 For brevity's sake I shall use the expression "rays"; and to distinguish them from others of this name I shall call them "X-rays."

covered with layers of tin-foil, varying in the number of sheets superposed. Photometric measurements of these will be made when I am in possession of a suitable photometer.

5. Sheets of platinum, lead, zinc, and aluminium were rolled of such thickness that all appeared nearly equally transparent. The following table contains the absolute thickness of these sheets measured in millimetres, the relative thickness referred to that of the platinum sheet, and their densities:

Thickness	Relative Thickness	Density
Pt 0.018 mm.	1	21.5
Pb 0.05 "	3	11.3
Zn 0.10 "	6	7.1
Al 3.5 "	200	2.6

We may conclude from these values that different metals possess transparencies which are by no means equal, even when the product of thickness and density are the same. The transparency increases much more rapidly than this product decreases.

6. The fluorescence of barium platino-cyanide is not the only recognizable effect of the X-rays. It should be mentioned that other bodies also fluoresce; such, for instance, as the phosphorescent calcium compounds, then uranium glass, ordinary glass, calcite, rock-salt, and so on.

Of special significance in many respects is the fact that photographic dry plates are sensitive to the X-rays. We are, therefore, in a condition to determine more definitely many phenomena, and so the more easily to avoid deception; wherever it has been possible, therefore, I have controlled, by means of photography, every important observation which I have made with the eye by means of the fluorescent screen.

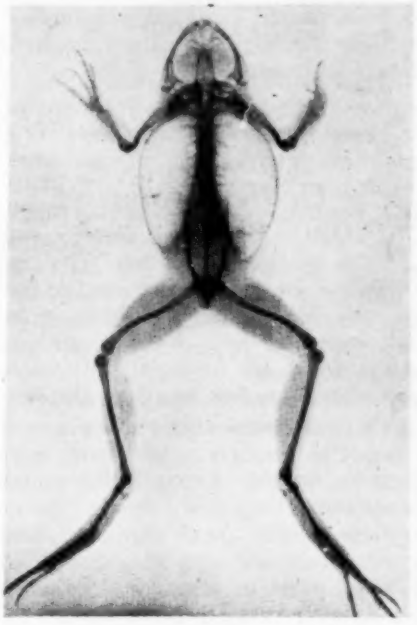
In these experiments the property of the rays to pass almost unhindered through thin sheets of wood, paper, and tin-foil is most important. The photographic impressions can be obtained in a non-darkened room with the photographic plates either in the holders or wrapped up in paper. On the other hand, from this property it results as a consequence that undeveloped plates cannot be left for a long time in the neighborhood of the discharge-tube, if they are protected merely by the usual covering of pasteboard and paper.

It appears questionable, however, whether the chemical action on the silver salts of the photographic plates is directly caused by the X-rays. It is possible that this action proceeds from the fluorescent light which, as noted above, is produced in the glass plate itself or perhaps in the layer of gelatin. "Films" can be used just as well as glass plates.

I have not yet been able to prove experimentally that the X-rays are able also to produce a heating action; yet we may well assume that this effect is present, since the capability of the X-rays to be transformed is proved by means of the observed fluorescence phenomena. It is certain, therefore, that all the X-rays which fall upon a substance do not leave it again as such.

The retina of the eye is not sensitive to these rays. Even if the eye is brought close to the discharge-tube, it observes nothing, although, as experiment has proved, the media contained in the eye must be sufficiently transparent to transmit the rays.

X-rays were quickly pressed into service by the biologist as well as by the physicist and the physician. This somewhat unusual view of a frog was an early triumph of X-ray photography.



7. After I had recognized the transparency of various substances of relatively considerable thickness, I hastened to see how the X-rays behaved on passing through a prism, and to find whether they were thereby deviated or not.

Experiments with water and with carbon disulphide enclosed in mica prisms of about 30° refracting angle showed no deviation, either with the fluorescent screen or on the photographic plate. For purposes of comparison the deviation of rays of ordinary light under the same conditions was observed; and it was noted that in this case the deviated images fell on the plate about 10 or 20 millimeters distant from the direct image. By means of prisms made of hard rubber and of aluminum, also of about 30° refracting angle, I have obtained images on the photographic plate in which some small deviation may perhaps be recognized. However, the fact is quite uncertain; the deviation, if it does exist, being so small that in any case the refractive index of the X-rays in the substances named cannot be more than 1.05 at the most. With a fluorescent screen I was unable to observe any deviation.

Up to the present time experiments with prisms of denser metals have given no definite results, owing to their feeble transparency and the consequently diminished intensity of the transmitted rays.

OTHER substances behave in general like air; they are more transparent to X-rays than to cathode rays.

11. A further difference, and a most important one, between the behavior of cathode rays and of X-rays lies in the fact that I have not succeeded, in spite of many attempts, in obtaining a deflection of the X-rays by a magnet, even in very intense fields.

The possibility of deflection by a magnet has, up to the present time, served as a characteristic property of the cathode rays; although it was observed by Hertz and Lenard that there are different sorts of cathode rays, "which are distinguished from each other by their production of phosphorescence, by the amount of their absorption, and by the extent of their deflection by a magnet." A considerable deflection, however, was noted in all of the cases investigated by them; so that I do not think that this characteristic will be given up except for stringent reasons.

12. According to experiments especially designed to test the question, it is certain that the spot on the wall of the discharge-tube which fluoresces the strongest is to be considered as the main centre from which the X-rays radiate in all directions. The X-rays proceed from that spot where, according to the data obtained by different investigators, the cathode rays strike the glass wall. If the cathode rays within the discharge-apparatus are deflected by means of a magnet, it is observed that the X-rays proceed from another (*Turn to page* 287)

Radio Fever

THE latest wonder of science is the proposed application of radio to the treatment and cure of disease. A way has been found to make the short radio waves that unite continents produce fever in the bodies of animals and men, and fever which can be controlled is the latest weapon man has found against disease.

The apparatus which makes possible this use of the short radio waves has been developed by Charles M. Carpenter and Albert B. Page of the Research Laboratory of the General Electric Company. The new apparatus was demonstrated at the recent meeting of the American Physical Therapy Association with the New England Physical Therapy Society.

While heat has long been used in the alleviation of pain and in the treatment of some diseases, recently it has been found that the germs of certain diseases can be killed in the body by high temperatures. It is considered likely that the fever is not just a sign of disease but is part of the body's defense against the invading germs. So physicians have been trying various means of producing fever to help the body along in its fight against the disease.

This method of treatment has been used with some success for paresis. The fever has been produced by various agents, such as continuous hot baths and injections of malaria germs which will produce fever in the body. However, it is difficult to produce just the desired amount of fever by these means, and in the case of the malaria injections, after the patient has been relieved of the original condition, he must be cured of the malaria. The new apparatus using short radio waves may overcome these objections and provide a practical means of using the fever treatment.

So far, and for the immediate future, the new apparatus is intended to be used only in scientific investigations. It will not be sold, but will be loaned to competent research groups for further study.

Medicine—Radio
Science News-Letter, May 3, 1930

Tiny Fossils

FOSSILS of tiny extinct animals of mouselike size have been found in considerable numbers by a patient search with a medium-power microscope, through blocks of compact earth taken from the Bighorn Basin in Wyoming. At the meeting of the American Philosophical Society Prof. Glenn L. Jepsen of Princeton University told of researches in "micro-paleontology" carried on by members of recent expeditions sent out into the fossil-bed country of the West.

At first the geologists worked the deposits which they found for the bones and teeth of large animals and birds. After they had picked over the ground pretty well, it was noticed that there were many tiny bones mingled with the bits of shale, and a search for "micro-fossils" was begun. It was a good deal like some modern mining operations, in which old ore dumps are re-worked for small quantities of valuable metal which the older miners either could not extract or would not bother to take. Many of the minute bones that showed up in the field of the microscope represent animals quite new to science.

A considerable proportion of the laborious examination of the fossil-filled earth was done by a Princeton senior, Joseph F. Page, who was rewarded by the discovery of one of the new animal genera. His find has been named *Teilhardella chardini* for Pére Teilhard de Chardin, noted French paleontologist.

Archaeology
Science News-Letter, May 3, 1930

Early Celtic Feminism

DIVORCE by mutual consent was one of the "up-to-date" customs of Ireland in the early centuries before the Middle Ages. A form of trial marriage was known, and so was a kind of financial settlement somewhat like our modern alimony.

Celtic women, though ordinarily under the guidance of their male relatives, might become independent members of the family, holding property in their own right. These women assumed the responsibilities of men, even to financing the wars and fighting in battle.

Some little known institutions of the old Celtic family life were described before the annual meeting of the Catholic Anthropological Conference by Rev. J. A. Geary, of the Catholic University of America.

Father Geary's researches into Celtic literature show that these people of northern Europe had complex regulations which guided their family affairs. A man's first wife was his legal wife. If he was wealthy enough to take a secondary wife into his home, the legal wife might demand a financial settlement, known as an "honor price." The secondary wife was sometimes taken on trial, for a year and a day.

In contrast with these bygone customs, Mr. Shi-Lin Chao, of the Johns Hopkins University, told of the present-day conservative Orient. Trial marriage is unknown in China, he stated. Divorce is extraordinary and is practically impossible. Even a childless wife is not commonly divorced, in spite of the Chinese longing for a son and heir to perpetuate the family.

The younger generation of China are in revolt against the match-making system of their elders, Mr. Shi-Lin stated. Explaining the psychological effect of a marriage between a couple who were literally strangers, he compared it to a tea kettle. A humorist had once said that western marriage is like a kettle of boiling water taken off the fire to cool. This contrasts with the Chinese marriage, the speaker said, for it is like a kettle of cool water put on the fire to heat.

The conference emphasized that missionaries and social workers need to understand the whys and wherefores of strange customs that prevail among the people they seek to convert.

Missionaries sent out by the Catholic church are now being urged to write down in detached scientific fashion their observations on primitive tribes and alien civilizations, and to send back their notes for the benefit of science.

Illustrating the sort of ethnological facts that religious workers should understand, six speakers described family institutions, ancient and modern, showing the great power of the traditions and regulations that surround the family in every age and land.

Anthropology
Science News-Letter, May 3, 1930

Hot Dogs

HOT dogs were enjoyed by hungry Mayan Indians of the tropics long before white men came to America.

But the Indian hot dogs were the real article, not the kind sold in civilized America today. J. Eric Thompson, archaeologist at the Field Museum of Natural History, reports that large numbers of dogs were bred by the Mayas and Aztecs for hunting, sacrifice, and eating. Hunting dogs

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were kept thin. Those for eating were fattened.

When the Spaniards came to Mexico early in the seventeenth century these native customs provoked their interest. One writer stated: "For want of children they (the natives) sacrificed dogges: they nourish also dogges to eate, as our nation doth conies: which dogges cannot bark, and have snouts like foxes."

Archaeology
Science News-Letter, May 3, 1930

Stone Age in Egypt

EGYPT had stone age inhabitants in times quite as remote as the oldest definitely known for Europe or any other part of the world. Compared with these earliest comers, who lived on the Nile while it was still an upland river flowing through a grassy plateau country, the pyramid-building Pharaohs are boys of yesterday.

The story of the Stone Ages of Egypt is told in a new publication of the University of Chicago Press by K. S. Sandford and W. J. Arkell, who conducted their explorations for the Oriental Institute of the University of Chicago.

The sides of the Nile valley, and of the side valley that constitutes the oasis of the Faiyum to the west of the lower Nile region, are marked in many places with erosional terraces. The oldest terraces were cut while the river and the branches it then had were flowing at the level of the present desert plateau. As one descends the sides of the present valley each succeeding terrace is younger than the one above it.

The four uppermost and oldest terraces bear no traces of human occupation. The fifth terrace has yielded great quantities of the two oldest types of well-worked flint implements, known to archaeologists as Chellean and Acheulian. Below this comes a sixth terrace, which in the Faiyum basin was formed by a lake which at that time filled most of the valley. This was the home of a race of men who made implements of the type known as Mousterian. Mousterian culture in Europe is typical of the Neanderthal species of human beings, but no bones have been found in Egypt as yet, so that it is impossible to say what the shapers of these flints did look like.

Below the Mousterian terrace comes a series of younger lake terraces, whose flints, though presumably contemporaneous with those of the various Cro-Magnon cultures of Europe, do not resemble them in appearance. These close the Old Stone Age, and a concluding stage bridges the gap to the New Stone Age. The latter period in its turn ushered in the beginnings of the civilized Egypt of the Pharaohs.

Archaeology
Science News-Letter, May 3, 1930

Prehistoric Relics

CLUES to three separate types of prehistoric inhabitants of the Cimarron Valley of Oklahoma and New Mexico were described by Dr. E. B. Renaud of Denver, speaking before a meeting of the Southwestern Division of the American Association for the Advancement of Science.

Two of these prehistoric cultures are known for the first time through discoveries made by an expedition of the past season, Dr. Renaud said. The expedition was conducted by Dr. Renaud, from the Colorado Museum of Natural History.

Some of the early groups who found their way to this valley frequented the rock shelters of the fumaroles, or steaming holes of volcanic origin, the expedition found. Stone and bone weapons used to hunt bison and deer were discovered. Later generations of these hunters evolved a metate for grinding meal.

Traces of prehistoric men who no longer depended altogether on hunting for a living, but who settled down to farming, were also found. These cave-dwellers of western Oklahoma and northeastern New Mexico cultivated corn and knew how to make baskets and sandals, the discoveries show. Their stone tools and weapons were better than the fumarole people had made. Some of the red colored paintings that they left on the rocks can still be seen.

The third type of culture from the region is represented by discoveries at Folsom, New Mexico, which have caused much controversy among scientists for several years. These relics are arrow or spear points lying with bones of extinct bison. If the stone points were shot at the living bison, as Dr. Renaud and a number of other scientists are convinced they were, it argues for the discovery of America by primitive men in the early days when such extinct animals were still alive, that is, thousands of years ago.

Archaeology
Science News-Letter, May 3, 1930

Second Trans-Neptunian

ANOTHER trans-Neptunian planet has been located on old photographic plates at the Dominion Observatory, Ottawa, Canada.

This tenth planet of the solar system, if further observations bear out the planetary nature tentatively assigned to it, will make this year notable in astronomical discovery. When, on March 13, Lowell Observatory announced the finding of the ninth planet, far beyond Neptune, then the farthest known outpost of the planetary system, the world was startled. Now arises the possibility that there are two planets beyond Neptune, both about four thousand million miles from the sun or forty times the earth's distance from the sun.

Dr. F. C. Henroteau, astrophysicist of the Dominion Observatory, and Miss M. Burland, his assistant, early in April were looking over photographic plates made in 1924 in the hope of finding on them the image of the Lowell Observatory planet X. They rejoiced when they found a faint object in about the proper position. But further study convinced them and Dr. R. Meldrum Stewart, director, that they had thus discovered another hitherto unknown planet, which may be called planet Y.

So far planet Y is known to science only on three photographs taken in 1924. It has not yet been photographed or seen this year. In 1924 it was in the portion of the sky described astronomically as right ascension six hours thirty-six minutes and declination north twenty-three degrees forty-two minutes. This is a little west of but close to where the Lowell planet X should have been at that time. But the position of the heavenly object on the Dominion Observatory plates was enough different to cause Drs. Stewart and Henroteau to announce the probability of the finding of another planet.

Astronomers are now expected to start a search for planet Y in the skies of today. In 1924 it had a brightness of magnitude about 15 or 16.

Recent computations of the orbit of the Lowell planet showed that it is moving in a much longer ellipse about the sun than any of the other planets. Some astronomers suggested that planet X is actually a new kind of member in the solar system. This contention may be borne out by further investigations of the nature of the Dominion planet Y.

Astronomy
Science News-Letter, May 3, 1930

Venus Races With Jupiter in May

Astronomy

First American Planetarium Will Open in Chicago

By James Stokley

EVERYTHING in the heavens is moving. Not only do the sun, the moon, and the stars move across the sky once a day because the earth itself is turning from west to east, but all these things are moving among themselves. Every year the sun makes a complete circuit of the stars. Every twenty-eight days the moon makes a similar round trip. And in periods of varying lengths, the various planets move among the stars. Even the stars themselves are moving, though much more slowly, so that at a time many thousands of years in the future, our familiar constellation figures will no longer exist.

Ordinarily, the motion of the planets is not easily apparent. Though Jupiter, for instance, makes a circuit of the sky in about twelve years, as you watch it from night to night you do not notice any appreciable movement. It has been visible in the evening sky for months in the constellation of Taurus, the bull, just above the bright red star Aldebaran. Just now it is moving slowly to the east, but during the whole month of May it will only move a distance about equal to the diameter of the full moon.

This month, however, the planet Venus will run a race with Jupiter, overtaking it on May 17. On the first of the month, you can see Venus as a brilliant star low in the western sky shortly after sunset. To the left is Aldebaran, though much inferior in brightness. Brighter than any star in the vicinity, you should have no trouble identifying Venus. Higher up is Jupiter.

As the month advances, keep your eye on these two planets, checking their positions every clear night. Each night Venus will appear a little higher, and the distance separating it from Jupiter will become smaller. On May 15, it will pass the place where Jupiter was on the first, but that planet itself will have advanced a little farther. Not until two days later, on May 17, will it actually pass. At about noon, Eastern Standard Time, on that day the two objects will be closer together, when Venus will be a little less than three moons' diameters to the north of its big brother. The astronomer calls this a conjunction of Venus and Jupiter. By evening, the two planets will have separated slightly, but they will still be close together, making a brilliant couple in the western sky; Jupiter on the left, and the even more brilliant Venus to the right.

But not for long will they be in this close proximity. Venus will continue on its way, until, by the end of the month, it will have passed over into the next constellation, Gemini, the twins, characterized by the two bright stars Castor and Pollux. By that time, the moon will have entered the race. The moon is new on the 28th, which means that it is on line with the earth and sun. The next evening, if you look carefully in the gathering dusk, you will see the narrow crescent moon to the north of Jupiter. Luna requires but a single day to traverse the space covered by Venus in two weeks, and on the 30th it will pass Venus. The conjunction of the moon and Venus takes place on the afternoon of the 30th, but in the evening they will still be close enough to make an interesting sight.

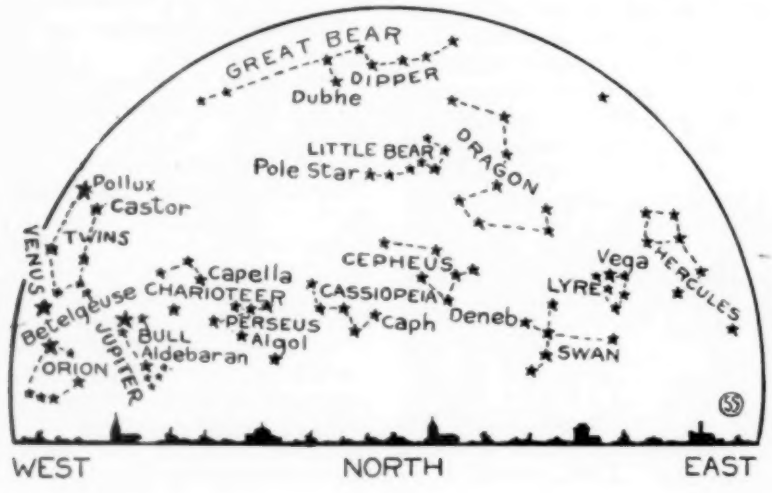
After this month, Venus will continue to rise in the evening sky, until on the 13th of September, it will be more than forty-five degrees east of the sun and visible for several hours in the western evening sky. After that it will approach nearer to the sun, but will increase in brilliancy until the 18th of October. Then it will rapidly approach the sun until, on the 22nd of November, it will again be on line with the sun and earth, soon afterwards to reappear as a morning star before sunrise.

Slow though these motions are, they are readily apparent if you watch the skies night after night. But after this month, visitors to Chicago will have the chance of seeing the thing repeated at will. During May there is to be opened the first American planetarium. This is the remarkable German instrument which has been installed in a number of European cities and which is a realistic representation of the skies at any time as seen in any part of the world. Another such instrument has been ordered for Philadelphia, but it will be a year or more before it is opened to visitors.

With Venus attaining such prominence in the evening sky, you may wonder what sort of a body it is. Astronomers know a good bit about the planet and, on the basis of what they do know, they are able to surmise even more. Recent months have brought the solar system into the public eye more than it has been for a long time.

The discovery by Lowell Observatory astronomers of an unknown member of the solar system revolving in an orbit far beyond that of Neptune, previously the most distant known planet, has drawn attention to its brothers and sisters in the family to which our own earth belongs.

The new planet, if it is a planet, travels in an orbit that is a very much

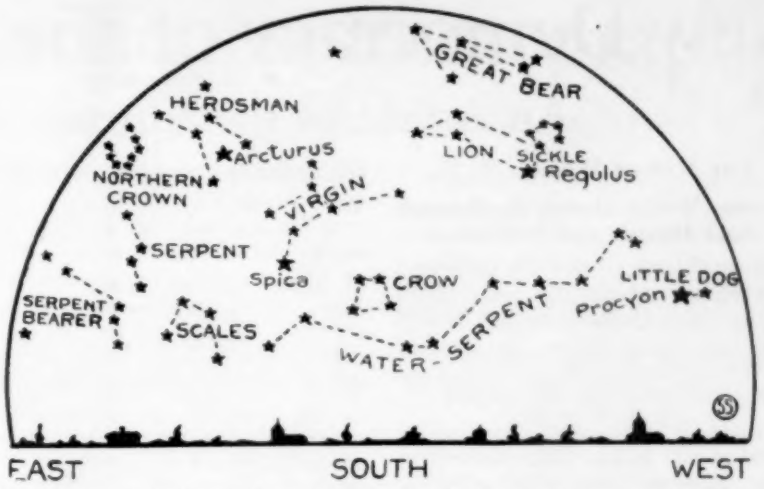


These maps show you the sky as it appears these May evenings. Hold them in front of you, and face north or south, and you can identify the stars in the heavens.

pulled-out ellipse, according to the preliminary computations of the astronomers who made the discovery. All the planets move in ellipses, but some are nearly circular. Venus is the most circular of all, as shown by the value for what is called its "eccentricity." A circle has an eccentricity of zero. As it stretches out into a longer and longer ellipse, the eccentricity increases until, when it finally stretches to an infinite distance, its eccentricity is one. Then it is no longer an ellipse, but a parabola. The new planet appears to have the highest eccentricity of all, for it is 0.909. This, however, is rather uncertain, but that for Venus is very well known. The distance of Venus from the sun is, on the average, about 67,200,000 miles and it revolves about its orbit once in 225 days. This is the "year" of Venus, but a longer period is required for the same position of the planet, as seen from the earth, to reoccur. The earth itself is moving around its orbit once in 365¼ days, so once in 584 days does Venus pass us.

If you look at Venus now, through a moderate sized telescope, you will see that it does not present a complete circle, but is like the moon a few days before full. During the coming month Venus gradually narrows to a crescent until November, when it is between the sun and earth. These changing phases are caused in precisely the same way as those of the moon. When the moon, or Venus, is illuminated by the sun at its side, we only see half of the bright surface, and the effect is the half moon. When the sun and the earth are both on the same side of either Venus or the moon, then we see the entire illuminated surface, the full phase. When one of the two objects is between the earth and sun we see a very small piece of the bright hemisphere, or a narrow crescent.

The discovery of the phases of Venus was made by the Italian astronomer Galileo, shortly after he first applied the telescope to the heavens in 1610. It provided strong evidence in favor of the theory of Copernicus, that the earth revolved around the sun instead of the sun revolving around the earth, as previously supposed. Under the old Ptolemaic theory, Venus was always beyond the moon, and could, therefore, never show a crescent phase. When Galileo found that Venus imitated the phases of the moon in their entirety, it immediately proved that the Ptolemaic theory was incorrect in at least one respect.



In 1924, when Mars approached within some thirty-five million miles of the earth, it attracted a great deal of attention, and many observatories made a careful study of its surface. Venus comes even closer, and when it reaches inferior conjunction this November, it will be only about twenty-six million miles from the earth. But no observatories will then be watching it, for it will be so close to the sun that it can not been seen with even large telescopes. Though Venus approaches nearer to us than any other of the planets, we do not know as much about its surface as we do of Mars. If there should happen to be any astronomers on Venus, however, at the time of inferior conjunction, they would see the earth as an extremely brilliant object high in the sky at midnight and extremely well adapted to observation. With instruments equivalent to ours, probably they would be able to see such evidence of human activities as the deforestation of large areas, or the growth of vegetation over large reclamation projects in the Southwest. Our moon would also be conspicuous to the people on Venus, and with the naked eye would be seen of about the same brilliance as Jupiter. The earth and the moon would appear really as a double planet, the moon swinging back and forth to one side or the other every twenty-eight of our days.

Of course, there is no evidence at all that there is any kind of life on Venus. Astronomers have to suspend judgment on this matter, and probably will have to continue to do so until a time in the far distant future, perhaps, when the problems of traveling through space can be solved. Even if Venus were as well placed as Mars, we could not learn much about its surface conditions, because we cannot see the surface. It is surrounded, like the earth, with an atmospheric layer. One proof of this is that at times when it is close to the sun, on our side, instead of appearing merely as a narrow crescent, the bright circle of light extends more than half way around. This would be produced in the same way as twilight on the earth, by the spreading of the light in the atmosphere.

In watching it through the telescope we seldom see more than a vast area of white, completely lacking in detail. Probably this means that the planet is continually covered by clouds, which always hide the surface. Sometimes hazy marks are seen, though it is believed that these are in the cloudy layer and not on the surface. On account of these facts, it has been quite difficult to determine how rapidly Venus rotates on its axis.

Though no other naked-eye objects appear in the May evening sky, there are plenty of bright stars to be seen. In the northeast, the brilliant Vega, in Lyra, the lyre, is coming into view. Low in the southeast, rising higher as the night advances, is the red Antares, in Scorpius, the scorpion. Almost directly south is Spica, in Virgo, the virgin, and to the southwest is Regulus, in Leo, the lion. Regulus is at the bottom of the hook-shaped group of stars known as the sickle. Low in the west is Procyon, in Canis Minor, the little dog, while above it and to the right is Pollux, the brighter of the twins. To the southeast of the zenith is Arcturus, in Bootes; Capella, in Auriga, the charioteer, is low in the northwest; while quite low in the northeast, not far from Vega, is Deneb in Cygnus, the swan.

New Democracy of the Favored Many

Public Health

An Article by the Secretary of the Interior

By Ray Lyman Wilbur, M. D.

Chairman, White House Conference on Child Health and Protection

THE problems of child health and protection which the year 1930 and this May-Day—National Child Health Day bring before us demand a real understanding of the forces of science at work in our democracy.

Democracy has not essentially changed men. It has not made them greater or more noble. Men of today are not stronger than Sampson nor are our modern athletes swifter runners than those of the Marathon. Christ developed in an atmosphere that would be abhorrent to today's sanitary civilization. Yet he offered a way of living, a philosophy, a moral code that has not been exceeded in this age or in any other. Human beings are inherently today what they were four thousand years ago.

Under democracy, however, greater masses of men are being made strong, greater masses of youth are trained in athletic programs to be swift runners, greater masses of children and youth are being educated—even highly educated and expertly trained. Instead of the favored few, democracy has developed the favored many.

Thus, side by side with the mass attitude and mass action that belong to democracy, science has developed the favored many. In public health, in mental and social health, in welfare, in education and in invention, science has been directed to the benefit of human beings.

Between the principles of science and the principles of democracy, however, there is a sharp distinction. The laws of democracy are made by majority rule, by the vote tossed in the ballot-box by the individual citizen who may be a man of great mind greatly trained, or a man who is hardly more than literate. The laws of science are not established by mass vote. They have nothing to do with the will of the people. Science has only one rule—the truth of the universal laws controlling the universe.

The problem of harmonizing science and democracy is one of the great questions facing scientists, educators, and leaders. The perfect answer to the question will be given when democracy takes the experts in with it, to blaze the trails and to direct the development of every national activity which affects the health, happiness, and success of all the people.

The democracy of the United States is beginning to do this today. An important example is the White House Conference on Child Health and Protection where more than five hundred experts are studying everything that science teaches today about the health and well-being of children. When their study is complete, our democracy will learn from it what each community and each state can do to ensure that the purpose of democracy may be fulfilled in the life of each child—that is, the opportunity for health of body and mind, for happiness and for success.

The experts of the White House Conference cannot, of course, change the scientific truths that make one way of treating children right and another wrong. Such laws always act the same way and produce the same results. Electricity, for instance, does not change its rules with the changes in political administration. Nor can the experts who control electricity change their methods in handling electricity because of a change in political administration. Yet electricity, steam and similar forces are being put to use to build up the civilization of the United States.

And now through science, through the leadership of experts, men are learning more about themselves. Even within fifteen years, great advances have been made in public and personal health. One by one, through the skill and patience of expertly trained men, certain diseases have been driven out of the nation.

The simplest person today knows something, more than his parents at any rate, about nutrition. The humblest mother understands more than ever before about the care of her babies. And so it follows that just as fast as mothers and fathers everywhere learn to understand and use these discoveries of science, democracy and science will be harmonized in the United States. And mothers and fathers will learn just as fast as the educators lead them.

But even while the nation is adopting the truths of science and is applying them to improve life for us and for our children, it is likewise building a structure that may become a trap for human beings. The structure is built of steel, concrete, pavement, wires, artificial ventilation, and artificial lighting that turns night to day—a whole series of new things in the environment of human beings.

Because of these things, men are in danger of becoming mere menagerie animals, captured and caged by themselves. Here they will breed and bear the young—the children of 1950 and 2000.

Trees are being driven out of the environment of men and women and children—the flowers, the birds, the grass, the open spaces, all that makes life and happiness for human beings.

No matter how much the nation may know about public health, or about welfare, no matter how much mothers may know about nutrition and the care of their babies, trouble will seize the generation that has been captured and caged and reduced to the status of menagerie animals. The problem of environment, therefore, is a bitter and difficult problem confronting the parents of today's children.

There is a further problem which both science and democracy increase. Personality is the greatest possession the child has, but under the domination of mass thinking and mass action and of science, it is difficult to preserve personality. It is becoming more and more difficult in the United States for it to find expression, except in the old ways of sculpture, painting, poetry, or music.

In favoring the many, the schools of America today are under the necessity of trying to preserve the personality, the spark of individuality, in the children who come to them.

One of the most interesting experiments in (*Turn to page* 286)

Moon's Shadow at Eclipse Photographed

Astronomy

Fleeting Darkness on Earth Recorded From Airplanes

CLOUDS over the sun broke away at Camptonville, Yuba County, California, two minutes before the total phase of the solar eclipse of the sun. Only the lightest haze remained and the observations planned by the various expeditions located there were carried through successfully.

The Lick Observatory-Crocker expedition under the direction of Dr. J. H. Moore secured photographs of the spectrum of the solar atmosphere with two powerful spectographs fitted with plate holders moved by accurately tuned screens driven by motors to secure perfectly uniform speed. One spectograph recorded the spectrum in the violet-blue region from 3900 to 4650 Angstrom Units; the other, the spectrum in the orange-red region from 4861 to 6563 Angstrom Units. Both plates when developed proved to be in perfect focus. It will, of course, require months of careful study to interpret them fully.

Although the shadow which passed was only about three thousand feet wide and was supposed to be subject to a possible error of nearly fifteen hundred feet, the photograph of the corona taken with three cameras, one at the center, one near the northwest, and one near the southeast edge of the computed path, show that the actual path agreed closely with the predicted one as corrected by the latest computations. Since the duration of the totality was but one second these photographs of course give but little indications of the form of the corona. The times of second and third contact were accurately recorded with the aid of a short wave-length receiving set and a chronograph, thanks to the cooperation of the officials at the Naval Observatory at Mare Island who sent out a special set of signals.

A novel method of measuring the breadth of the shadow path consisted in stationing boy scouts at intervals of one hundred feet in a line at right angles and extending well beyond its possible boundaries. Each scout was to report whether or not the sun disappeared entirely for an instant.

In the immediate neighborhood of the Lick Observatory party Dr. R. L. Waterfield, an English amateur now connected with Johns Hopkins University, had set up a grating spectograph designed to secure records of the ultraviolet and also of the extreme infra-red regions of the spectrum of the solar atmosphere. He reports successful results.

A novel installation was that of Weld Arnold of the American Geographical Society, New York. He had two moving picture cameras on a single mounting so adjusted that one photographed the dial of a watch while the other synchronously photographed the narrowing crescent of the sun before totality and the growing crescent for a short time afterwards. This record should be the most accurate one of the instants of contact.

The total solar eclipse of April 28, like all such astronomical exhibitions of recent years, attracted to the narrow path of the moon's shadow many astronomers and laymen eager to witness the infrequent spectacle. The results of their observations are told in the accounts on this page.

The cover photograph shows, at the right, Dr. Hamilton M. Jeffers of Lick Observatory with the camera he used to photograph the moon's shadow on the ground from an altitude of ten thousand feet, and Lieut. E. B. Bobzien who piloted the Army airplane.

A number of amateur astronomers and moving picture companies were in a field making records of the eclipse.

In addition airplanes were brought into service successfully. The Army Air Service at Crissey Field, San Francisco, cooperated with the Lick Observatory by sending up two planes above the Napa Valley to an altitude of over ten thousand feet. An airplane carried Dr. H. M. Jeffers of the Lick Observatory equipped with a camera of two inches aperture and three and six-tenths inches focal length. The other carried army photographer Sergt. S. T. Bush, provided with a special camera. The weather was fine in that part of the state and Dr. Jeffers succeeded in photographing the moon's shadow as it swept over the ground beneath. This has never before been done. Sergt. Bush got good photographs of the sun.

The Pomona College Expedition, under the leadership of Prof. Frank P. Brackett, was stationed four miles southwest of the Lick Observatory parties and was equipped to carry out a similar program. He reports complete success. Two airplanes cooperated with Prof. Brackett.

This eclipse was unique in being the shortest one ever observed successfully and also in the great variety of observations secured.

Bailey's Beads

By Dr. Seth B. Nicholson
In charge Mt. Wilson Observatory Eclipse Expedition.

Bailey's beads were the most conspicuous feature of the sun's eclipse as seen from our location twelve miles from Doyle, Calif. They showed all around the sun during the whole of the time of totality.

A few minutes before the critical time of totality clouds that masked the sun blew past and a clear view was obtained. But more clouds came and at totality the sun was covered by thin clouds. Our photographs will not have much scientific value as far as photometric measures are concerned but some of the spectrographs may give results.

The corona was not visible on account of the clouds. We did, however, observe shadow bands upon the earth's surface. Our observations showed that the predicted time of the eclipse was correct to within two seconds at least.

The party of the U. S. Naval Observatory was busy with observations about a half mile away and two Navy airplanes were flying at eclipse time. The Navy pilots reported the clouds twelve thousand feet high and one flew at eighteen thousand feet.

Sunday was completely cloudy but our hopes for good weather were raised when it cleared that night. Monday dawned heavily clouded and it rained a little. At the time of first contact the sun was barely visible. Considering the cloudy weather of last week we were fortunate to get the view of the eclipse that we did.

Clouds

By Dr. Heber D. Curtis
Leader of Allegheny Observatory Expedition.

Thick clouds prevented the Allegheny Observatory expedition from making any eclipse observations from its station at Gerlach, Nev. Not a plate was exposed. (*Turn to page* 287)

Electrons Behave Like Waves

General Science

Physicist Describes Their Reflection By Crystal

ONE of the outstanding puzzles of modern physics—how electrons, once thought of as material particles, can behave sometimes like waves, while "waves" of light sometimes behave like particles—was discussed at the meeting of the American Philosophical Society by Dr. C. J. Davisson, of the Bell Telephone Laboratories. One result has been that the physicist no longer tries to imagine a model of every physical phenomenon.

Describing his own experiment, Dr. Davisson told how a stream of electrons aimed at the face of a crystal had behaved much as light does on striking a mirror. Most of them were shot back at the same angle to the surface layer of atoms as they had approached.

"There is a strong and well defined beam of regularly reflected electrons," he stated. "This is a phenomenon which is not predicted and cannot be explained if we insist on assuming that electrons are solely corpuscles much smaller than the individual atoms, for to such corpuscles the surface of the crystal must appear not as a smooth plane, but as a rough and broken field.

"Picture the crystal built up of atoms, each of them enormous in size compared to an electron and each of them comprising a nucleus surrounded by a larger number of electrons rotating in closed orbits. Imagine now an electron plunging into the galaxy of planetary systems. It is obviously a comet. The simplest event which may ensue will be a comet-wise deflection of the electron in the field of some atom into which it happens to strike, and then a speeding away of the electron from the crystals without loss of energy. The direction taken by the departing electron would be determined by a number of circumstances, one of which would be the distance of the line of approach of the incident electron to the nucleus of the atom responsible for its deflection."

"If we regard the beam of incident electrons as a beam of waves instead of as a stream of particles," he continued, "then each wave-front of the beam comes in contact with all the atoms of the surface, and the regular reflection is explained, as in the case of X-rays, as the result of constructive interference among the coherent secondary wave trains scattered by and proceeding from the regularly arranged atoms of the crystal."

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Favored Many—Cont'd

the American school system has been the determination to keep religion out and to get character in. The substitutes for religion, some think, have not been satisfactory. Because many of the great moral leaders are associated with religion, much of their influence and power have been denied our boys and girls in school. The schools need substitutes for the great moral leaders of the past and the question many ask is whether they are finding them.

If there is question as to national wisdom in side-stepping the influence of religion, there is no question as to the importance of cutting superstition out of the child's environment.

The future of education in our great democracy gives us anxiety. It must be different. Under it, boys and girls will be educated less in specific subjects so that a boy with a gift for science but no mind or interest for language will be acceptable in any university. Education will be directed not to subjects but to boys and girls. Its purpose will be to adapt each one to the environment science has created and to the society of democratic America. At the same time, it will preserve personality and health.

When the findings of the White House Conference are all in, the nation will know better how to protect its children, how to harmonize science and democracy in their lives. Any agency like May Day—National Child Health Day speeds the good work along!

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NATURE RAMBLINGS

By Frank Thone

Bloodroot

A GOOD theme for a botanist-poet might be supplied by the bloodroot, that now stars our woods. Such a one might well hail the little white flower as a "modest poppy" that

"Crowds back its carmine blushes to its root
And turns toward all ardors of the sun
A front demure and white as any nun."

For the bloodroot is really a close cousin of the poppy, and the red that its relative flaunts in its face, this little white spring blossom expresses only in its blood-red sap. It would not be exactly correct, however, to say that the red sap is found in its root, for the thick underground part of the plant is really a rhizome or subterranean stem, from which the true roots, as well as the overground stems, take their rise.

The sap is somewhat thick and milky under its red color, which is another point of kinship with the milky-juiced poppy tribe. And as the juice of the poppy contains a poisonous principle used in medicine, so also does the juice of the bloodroot. Under the Latin name "Sanguinaria" the dried rhizome used to find a more or less prominent place on druggists' shelves; though it is little used now.

The bloodroot is one of the small number of native American wildflowers that needs little warning against reckless bouquet-gathering, due again to that same thick, red, rather irritating j u i c e. Children picking flowers in the woods sometimes take a handful of its attractive, though short-lived, white flowers; but the appearance of their hands and dresses usually causes their alarmed mothers to place further bloodroot gathering under interdict.

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Roentgen's Rays—Continued

spot—namely, from that which is the n.w terminus of the cathode rays.

For this reason, therefore, the X-rays, which it is impossible to deflect, cannot be cathode rays simply transmitted or reflected without change by the glass wall. The greater density of the gas outside of the discharge-tube certainly cannot account for the great difference in the deflection, according to Lenard.

I therefore reach the conclusion that the X-rays are not identical with the cathode rays, but they are produced by the cathode rays at the glass wall of the discharge-apparatus.

13. This production does not take place in glass alone, but, as I have been able to observe in an apparatus closed by a plate of aluminium 2 millimetres thick, in this metal also. Other substances are to be examined later.

14. The justification for calling by the name "rays" the agent which proceeds from the wall of the discharge-apparatus I derive in part from the entirely regular formation of shadows, which are seen when more or less transparent bodies are brought between the apparatus and the fluorescent screen (or the photographic plate).

I have observed, and in part photographed, many shadow-pictures of this kind, the production of which has a particular charm. I possess, for instance, photographs of the shadow of the profile of a door which separates the rooms in which, on one side, the discharge-apparatus was placed, on the other the photographic plate; the shadow of the bones of the hand; the shadow of a covered wire wrapped on a wooden spool; of a set of weights enclosed in a box; of a galvanometer in which the magnetic needle is entirely enclosed by metal; of a piece of metal whose lack of homogeneity becomes noticeable by means of the X-rays, etc.

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Eclipse—*Continued*

Shadow Movies

Observations made by Mrs. Isabel M. Lewis, astronomer of the U. S. Naval Observatory, at Honey Lake, California, were successful. Bailey's beads but no corona was observed and it was determined that the path was correct as predicted and the time was right to within two seconds. U. S. Navy airplanes operating for the U. S. Naval Observatory secured one reel of motion pictures of the shadow from an elevation of eighteen thousand feet and from the ground Navy photographers made a reel of the eclipsed sun.

Best Prediction

The solar eclipse of April 28 upon the basis of preliminary reports has been proclaimed the most accurately predicted eclipse of record. Due to the very short totality and consequent narrow path, it was necessary to take into account the latest observations of the moon's position in making the final determination of the area from which the totally darkened sun could be seen.

The prediction made by James Robertson, director of the Nautical Almanac office of the U. S. Naval Observatory was fulfilled with greater accuracy than was to be expected.

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FIRST GLANCES AT NEW BOOKS

THE BOOK OF BIRD LIFE—A. A. Allen—*Van Nostrand*, 426 p., $3.50. Prof. Allen has been one of the country's most successful practitioners of the gentle but difficult art of living with birds, and in this book he gives us the first fruits of his love and labor. The reader, if at all sympathetic, is made to feel that he has not merely read something *about* birds; he has for the moment at least undergone an identification with them. And this without the loss of the true naturalist's "feel" and the true scientist's clean-cut knowledge.

Ornithology

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THE JAW-BREAKER'S ALPHABET—Eunice and Janet Tietjens—*Albert and Charles Boni*, 111 pp., $3.50. An A B C book of paleontology, mostly concerned with saurians. The rimes are sometimes clever, but the real charm of the book lies in the peculiar, white-on-black illustrations, which combine a considerable degree of scientific faithfulness with good design.

Humorous Paleontology

Science News-Letter, May 3, 1930

THE PARACHOR AND VALENCY—Samuel Sugden—*Knopf*, 224 pp., $4. The parachor is a measure of the volume of atoms and molecules corrected for the influence of internal pressure. The hypothesis is made that shared and unshared electrons make the same contribution to the parachor of molecules. Values can be obtained representing the parachors of the atoms and of the various known types of bonds, such as double bonds, triple bonds, etc. From these parachors the parachors of some 267 substances have been calculated and compared with the values obtained from measurements. The agreement is very satisfactory. Existing information concerning valency relations is brought together and discussed. The bearing of the parachor upon valency is then discussed. A chapter is added on the experimental methods used for obtaining the data from which the values of the parachor can be calculated. The facts presented concerning the parachor are worthy of study. The method of calculation used in deriving the parachor assumes that the contribution to the parachor of linkages such as exist between carbon and hydrogen atoms is zero. This is possibly an unfortunate interpretation of the facts.

Physical Chemistry

Science News-Letter, May 3, 1930

GUIDING THE CHILD—Alfred Adler and associates—*Greenberg*, 268 pp., $3. Tells of the methods used and results achieved at the twenty-eight child guidance clinics in Vienna, which are operated under the leadership of Dr. Adler. The Individual Psychology sponsored by Adler stresses the therapy of encouragement and aims to stimulate in the child a feeling of responsibility. Different types of child problems and different angles of the clinic technique are discussed by the physicians and educators connected with these Viennese clinics. There is a chapter by Dr. Adler himself, showing his handling of a single case in detail.

Psychology

Science News-Letter, May 3, 1930

THE ALIEN IN OUR MIDST—Edited by Madison Grant and Chas. Stewart Davison—*Galton*, 238 pp., $3. The opinions of many prominent Americans, including the founders of the republic as well as living statesmen, politicians, business men, and scientists on the engrossing subject of immigration. They, to quote the editors, "all are of a mind—that the introduction of discordant elements into our body politic is fraught with danger."

Immigration-Genetics

Science News-Letter, May 3, 1930

THE LIFE OF BIRDS—E. F. Daglish—*Morrow*, 236 p., $3. A completely written popular discussion of the natural history of birds, illustrated with black and white drawings in a most interesting style.

Ornithology

Science News-Letter, May 3, 1930

THE ALISHAR HUYUK, SEASON OF 1927—H. H. von der Osten and Erich F. Schmidt—*Univ. of Chicago Press*, 284 pp., $8. The first of two profusely illustrated volumes, presenting important discoveries made in the first season of excavation at this site of old Hittite civilization. The expedition by the Oriental Institute has been the first to reclaim pottery from the various levels of an undisturbed Hittite mound, thus providing a key to the chronology of these little-known inhabitants of the Near East. Buildings and the fortifications of the mound are described in this volume, as well as the pottery. The second volume, to follow, will deal with seals, coins, bone and metal objects, and the burials.

Archaeology

Science News-Letter, May 3, 1930

THE TITANOTHERES OF ANCIENT WYOMING, DAKOTA AND NEBRASKA—Henry Fairfield Osborn—*U. S. Government Printing Office*, 2 vols., $8. This work is one of the relatively few members of the annual flood of books that really deserve the too-frequently-applied adjective "monumental." For it sums up and concludes many years of work by the author on the remains of these weird and gigantic beasts that once roamed our West—labors wherein Dr. Osborn qualified as undisputed master of the workers in this particular field of paleontology and built a reputation that will endure far beyond the lifetime of his own generation. In nearly a thousand pages of text and over two hundred plates, he sets forth simply everything now known about titanotheres of the plains region. The literature on the subject now begins with this book. In addition to the exhaustive treatment of American titanotheres, there is a briefer section on the eocene and oligocene titanotheres of Mongolia.

Paleontology

Science News-Letter, May 3, 1930

SOCIAL PSYCHOLOGY—Bernard C. Ewer—*Macmillan*, 436 pp., $2.25. A simply written text, for students or general readers, on the problems of the human being versus society. The physiological mechanisms that link with mental processes are taken for granted, and the author deals in the shorthand terms of motives, instincts, learning, conflicts. The importance of thought as a social function is emphasized.

Psychology

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CHEMICAL DICTIONARY—Ingo W. D. Hackh—*Blakiston's*, 790 pp., $10. The first chemical dictionary in English in a century, this volume will find a ready welcome and a wide use among chemists and students. There is some inconsistency in the terminology and a few errors have crept in. However, it is probably 99 per cent. correct and may be safely recommended as a good usable work.

Chemistry

Science News-Letter, May 3, 1930

LABORATORY EXERCISES IN ZOOLOGY—W. M. Barrows—*World Book Co.*, 103 p., 48c. A well-planned laboratory manual that looks as though it ought to work.

Zoology

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